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A Comparison of the Cainozoic Volcanic Provinces of Victoria and Tasmania

By F. L. Sutherland

Tasmanian Museum, Hobart

Abstract

A comparison of the known Cainozoic volcanic histories of the Victorian and Tasmanian provinces indicates that there were distinct differences in the pattern of volcanicity in the two areas, although the petrology of the basaltic suites is similar.

Introduction

Volcanism was widespread in eastern Australia during the Cainozoic, and regional comparisons are of interest. This paper compares the Cainozoic volcanism in the Victorian and Tasmanian provinces, as far as known at present, and represents the basis of a paper given by the author at the 40th ANZAAS Congress in Christchurch, New Zealand, in January 1968.

Comparisons between the Cainozoic volcanic rocks of Tasmania and Victoria were made by Edwards (1950), following scattered sampling of the Tasmanian rocks, and he concluded that the relationships of petrology and eruptive age known in Victoria probably did not hold in Tasmania. Since Edwards's study, however, some of his data on ages of sub-basaltic sediments have proved invalid (see Sutherland and Corbett 1967). As considerably more information on Tasmanian Cainozoic volcanic successions is now available, a further review is justified.

Victorian Volcanism

Cainozoic volcanicity in Victoria is considered to be grouped about two maxima, one in the Eocene and the other in the Pliocene-Pleistocene (Singleton 1965). The Older Volcanic Series outcrops largely in Eastern Victoria, the parent magma belonging to the alkali olivine-basalt suite with an average SiO_2 content of about 46% (Edwards 1938). Lavas range from undersaturated olivine-basalts, some with basanitic affinities, to near-saturated olivine-basalts. Subordinate alkali differentiates include olivine-nephelinites, limburgites, and more rarely tinguaites, phonolites, and mugearites.

The Newer Volcanic Series outcrops almost entirely from Central to Western Victoria. Isotopic dating of the lavas (McDougall, Allsopp & Chamalaun 1966) gave ages ranging from 4·5 to 0·6 million years and radio-carbon dating (Gill 1964) indicates that volcanism occurred as recently as 5,000 years ago. The parent magma was more saturated than that of the Older Volcanic Series, with an average SiO_2 content of about 50% (Edwards 1937). Lavas range from near-saturated to saturated olivine-basalts, and subordinate alkali differentiates include limburgitic, mugearitic, trachytic, and sodic trachytic rocks.

Tasmanian Volcanism

In Tasmania the Cainozoic volcanic rocks show a similar compositional range to the Victorian rocks, although some differences can be noted. Montieellite and

melilite bearing rocks amongst the undersaturated alkaline rocks in Tasmania (Edwards 1950) are unknown in Victoria. On the other hand, acidic differentiates of phonolitic and trachytic character as in Victoria, are as yet unrecorded from Tasmania. Small dykes and flows of hornblende-andesites have been discovered recently by D. J. Jennings and the author at Cape Portland, NE. Tasmania, post-dating Jurassic dolerite, but their precise age is unknown. These may represent acidic differentiates associated with nearby outcrops of typical Cainozoic olivine-basalts, but more probably represent the source of volcanic fragments in Lower Cretaceous sediments in Southern Victoria (Singleton 1965). Further, definite dates are not yet established for the phonolites and tinguaites attributed to the Older Volcanics in Victoria, and the possibility of a pre-Cainozoic age for these must be borne in mind, particularly as rocks of similar composition at Port Cygnet, Southern Tasmania, are dated as mid-Cretaceous (Spry 1962).

Several sections through Tasmanian Cainozoic volcanic sequences, with some age control, are now known and enable detailed comparisons to be made with Victorian sequences. Brief descriptions of these sequences are given below, and their probable stratigraphic relationships are summarized diagrammatically in Fig. 1. Summaries of the petrological characters of the Tasmanian basaltic suite are available from Edwards (1950) and Spry (1962).

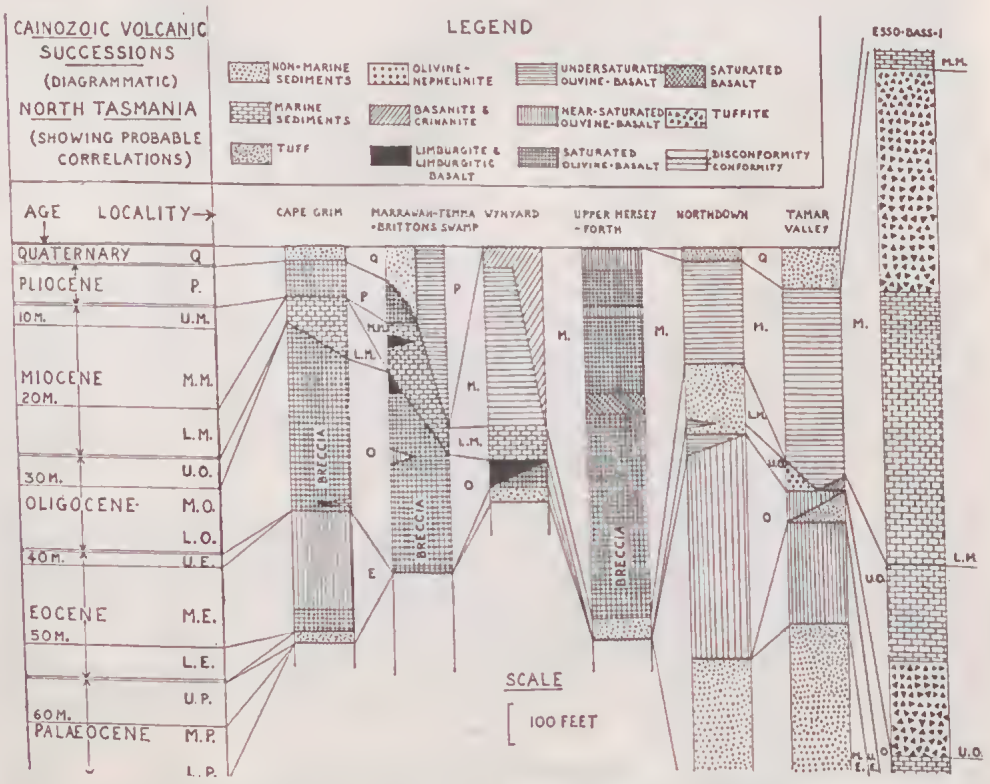

FIG. 1—Some Cainozoic volcanic stratigraphic successions (diagrammatic) in northern Tasmania, showing probable correlations.

(a) Cape Grim Area (Sutherland and Corbett 1967)

Lavas in this area disconformably underlie and overlie marine beds of Lower Miocene age, and stratigraphic considerations suggest that volcanic activity extended from Lower to Upper Tertiary time. The lavas are dominantly saturated olivine-basalts, with some near-saturated olivine-basalts.

(b) Marrawah-Temma-Brittons Swamp Area (Gill and Banks 1956; Sutherland and Corbett 1967)

Lavas at Marrawah are disconformably overlain by Mid-Miocene marine beds, and consist largely of saturated olivine-basalts, with some near-saturated olivine-basalt and limburgite. At Britton's Swamp 'palagonitised' and brecciated limburgite contains blocks of Miocene marine sediments (including pieces of Upper Longfordian age, P. G. Quilty, pers. comm.). A thick flow of undersaturated olivine-basalt disconformably overlies Lower Miocene marine beds at Mt Cameron West, and a flow of saturated olivine-basalt disconformably overlies Middle Miocene marine beds at Temma.

(c) Wynyard Area

Lavas underlie and overlie Lower Miocene marine beds in the area (Banks 1962; Quilty 1966; Gee 1966). Samples of the lavas from both above and below the marine beds were made available to the author for petrological examination by M. F. Harris following detailed mapping and sampling. Lava below the marine beds has been dated as Lower Tertiary on palaeomagnetic evidence (Green and Irving 1958) and these rocks include saturated olivine-basalt, limburgites and limburgitic basalts. Lavas overlying the marine beds are largely undersaturated olivine-basalts. The sediment/basalt contact appears generally comformable, and pillow-like lava occurs towards the base of the sequence just W. of Table Cape (R. D. Gee, pers. comm.). This may indicate eruption of lavas into the Miocene sea, but the evidence is uncertain. The highest part of the sequence appears to be basanite and is probably related to the intrusive neck of crinanite at Table Cape. The lavas are deeply weathered and lateritized in parts, suggesting an age not younger than Pliocene, and possibly pre-Pliocene.

(d) Upper Mersey-Forth Area (Spry 1958)

Pre-basaltic valleys in this area are filled with a succession of saturated olivine-basalts, near-saturated olivine-basalts and some saturated basalt. The lavas appear to have been erupted from centres near the Borradaile Plains and near Moina, where their age is established as probably Lower Miocene on palynological evidence (Paterson 1967).

(e) Northdown Area (Burns 1964)

Two separate basalt horizons are mapped in this area, and samples from both have been petrologically examined by the author. The older Thirlstane Basalt consists mainly of near-saturated olivine-basalt, and is disconformably overlain by non-marine beds dated as probably Upper Oligocene at the base, on palynological evidence. The sediments probably range up into the Lower Miocene and contain an interbedded flow of undersaturated olivine-basalt. The sediments are disconformably overlain by undersaturated olivine-basalt constituting the Moriarty Basalt, which is deeply weathered and lateritized suggesting an age not younger than Pliocene.

(f) Tamar Valley Area (Sutherland 1966)

The lavas in this area disconformably overlie Palaeocene-Middle Eocene non-marine beds. Detailed unpublished mapping and petrological studies by the author suggest that the lava succession in the Lower Tamar Valley consists of near-saturated olivine-basalts, with an initial Upper Eocene age, disconformably followed by flows of olivine-nephelinite and basanite, and finally a very thick flow of coarse undersaturated olivine-basalt. Considerable dissection and lateritization of the lava sequence suggests a probable pre-Pliocene upper age limit. This succession is of interest as it closely compares petrologically with that established for the Older Volcanic succession near Bacchus Marsh in Victoria (Jacobson and Scott 1937).

(g) Bass Basin (Esso Exploration Australia, Inc. 1966)

Drilling in the Bass Basin (Esso-Bass-1) approximately 75 miles north of Table Cape proved a sequence of 6,857 ft of Upper Cretaceous to Upper Miocene non-marine, marine, and volcanic rocks. The volcanic rocks in the sequence include some tuffaceous sandstone at the base of the Oligocene, and tuffite cones in the Upper Oligocene and Lower Miocene beds. The author has examined thin sections of the tuffites, but the highly altered state of the rocks makes the basalt type difficult to determine.

Further data providing some age limitations on Tasmanian Cainozoic volcanic rocks are also known at the following places.

(1) Stanley. The Nut, a probable neck of erinanite, has been dated as probably Lower Tertiary age on palaeomagnetic evidence (Edwards 1941; Gill and Banks 1956; Green and Irving 1958).

(2) Great Lake. At Skittle Balls Plain, basalt has been dated as probably Upper Cainozoic on palaeomagnetic evidence (Green and Irving 1958). Petrological examination shows that the rock is saturated basalt.

(3) Brighton. A flow of saturated olivine-basalt here is relatively little dissected, suggesting eruption in comparatively recent times, possibly in the late Tertiary (McDougall 1959).

(4) Branxholm. Undersaturated olivine-basalt associated with olivine-nephelinite (Edwards 1950) here overlies non-marine beds, dated as probably Lower Miocene on palynological evidence (Harris 1965). Edwards (1939) considered the flows to be relatively young, either Pliocene or younger.

(5) Granville Harbour. A small outcrop of silicified marine limestone in the area appears to be disconformably succeeded by non-marine deposits overlain by basalt (Blissett 1962). The limestone is probably Middle Miocene in age by analogy with similar marine beds in north-west Tasmania (Quilty 1966), suggesting a post-Miocene age for the basalt. Petrological examination shows the rock is a saturated olivine-basalt.

(6) St. Helens. Boring in Thureau's Deep Lead here encountered basalt flows disconformably below sediments of probable Lower Oligocene age, on palynological dating (Jack 1964). The petrology of the basalt is unknown.

Conclusions and Discussion

Hence the following points can be made, in comparing Cainozoic volcanism in Victoria and Tasmania.

1. The volcanism commenced approximately contemporaneously in the two areas, during the Lower Tertiary, probably by Eocene time.

2. The volcanism ceased a little earlier in Tasmania than in Victoria, finishing probably in Pliocene or Pleistocene time. No eruptive cones or flow surface features are known in Tasmania with the degree of preservation of examples in the Newer Volcanics of Victoria (Ollier & Joyce 1964).

3. The volcanism appears to have been generally continuous in its activity in Tasmania, and not grouped about two maxima as in Victoria (Fig. 2). In contrast to Victoria, volcanism was prevalent in the Miocene in Tasmania. Here Tasmania resembles north-eastern New South Wales, where recent isotopic dating of lavas (McDougall and Wilkinson 1967) indicated widespread and prolonged activity in the Miocene. However Pliocene volcanism in north-eastern New South Wales appears to have been lacking or more subdued than in Tasmania.

4. Tasmania does not show the distinct relationship between basalt type, eruptive age and regional distribution as found in Victoria. In Tasmania there was approximately concomitant extrusion of both saturated and undersaturated lavas throughout much of the Cainozoic. Thus, extrusions of saturated olivine-basalts, typical of the Newer Volcanics of Victoria, commenced at least as early as Oligocene and possibly as early as Eocene in Tasmania. Similarly, undersaturated olivine-basalts similar to those of the Older Volcanics in Victoria were widely erupted in the Miocene, probably continuing into the Pliocene, in Tasmania. However, it has been suggested recently that some basalts in the Melbourne area in Victoria, petrologically resembling the Older Volcanic rocks, may be as young as Upper Pliocene (Thomas, *et al.* 1967). Thus, when detailed dating of rocks attributed to the Older Volcanics is done, it may well be found that the Cainozoic volcanic history of Victoria approaches the Tasmanian pattern more than the present picture suggests.

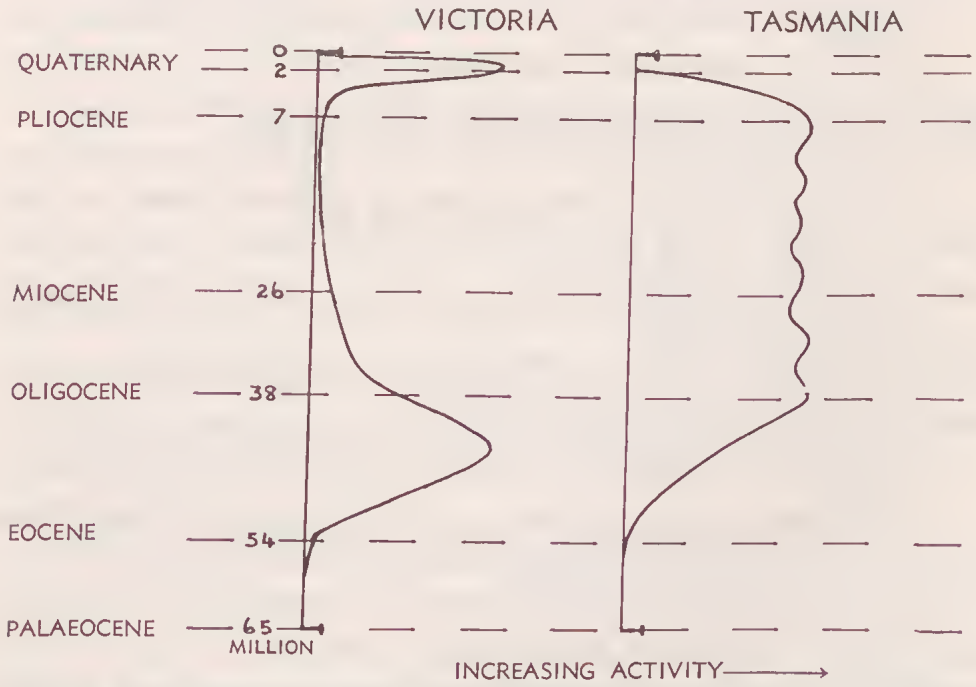

FIG. 2—Approximate comparative patterns of Cainozoic volcanic activity in Victoria and Tasmania.

In the final analysis, however, the comparisons indicate a distinct difference in the pattern of Cainozoic volcanism in Victoria and Tasmania.

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